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SELECTED TRANSLATIONS ON EAST EUROPEAN HEAVY INDUSTRY

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SELECTED TRANSLATIONS ON EAST EUROPEAN HEAVY INDUSTRY

No 9

This is a serial publication containing selected translations on the manufacturing and chemical industries in Eastern Europe.

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EAST GERMANY

MODERN CARD PUNCH MACHINES

/Following is the translation of an article by Mr. Klein, VEB Buromaschinenwerk Sommerda, in Technische Gemeinschaft (The Technological Community, Vol 9, No 2, February 1961, pages II-III)./

Card punch machines (Lochkartenmaschinen), designed by the VEB Buromaschinenwerk Sommerda and the VEB Elektronische Rechenmaschinen Karl-Marx-Stadt, were first exhibited at the Leipzig Fall Fair in 1960. They were shown again in Bugra-Haus during this year's Spring Fair with some further improvements.

The great number of interested domestic and foreign visitors of the Fall Fair have already proved that from now on the greatest possible attention should be paid to designing card punch machines. These machines are well suited to reach a higher degree of mechanization of data processing, thus making a great contribution to the fulfillment of economic tasks within the Seven-year Plan.

Card punch machines, such as the magnetic punch machine (Magnetlocher), magnetic checker (Magnetprufer), sorter (Sortiermaschinen), tabulator machine (Tabelliermaschinen), summary punch machine (Summenlocher), electronic calculating punch (Elektronensaldierer), electronic computer (Elektronenrechner), and all possible mechanical combinations of these machines designed and already put in series production, enable the introduction of the card punch technique in all fields of industry, trade, administration, statistics, and scientific institutions. The application of these machines is particularly significant because their analyses lead to a faster growth of knowledge, which on the other hand improves the organization and planning of the respective application fields and encourages economy. At the same time, costs go down because of the elimination of manual work. Much manpower will thus be obtained for other activities.

All card punch machines designed so far, apart from various electronic attachments, operate on the basis of an electric-mechanical principle and are well suited for the processing of the well-known 80-column punch cards of international standard size.

1. Magnetic Punch Machine Type 413 (Picture 1)

This device is designed as a step punch machine with a column-type card conveyance system. The loading and discharge of the cards and the keying of corresponding figures and terms must be done manually, while the punching itself and the card progression occur by means of electric magnets. The adjustable carriage stroke (so as to choose arbitrarily the place where cards are to be punched), the indication of corresponding

columns to be punched, and a tabulator for skipping those columns which are to be omitted in punching are the most significant characteristics of the magnetic punch machine type 413.

2. Magnetic Checker Type 423 (Picture 2)

Checking punch cards is done by means of a magnetic checker which is similar in basic design to the magnetic punch machine type 413. A set of brushes attached to the punching mechanism touches progressively the columns previously punched and produces electric impulses which disengage the carriage. In addition to the mechanism mentioned already in connection with magnetic punch machines, the magnetic checker type 423 is provided also with a switch for "skipping," which enables skipping unpunched zones of the punch card and simultaneous checking of faulty punchings, which is optically indicated by the use of a control light.

3. Sorter Type 432 (Picture 3)

The sorter type 432 enables, at a sorting speed of 42,000 cards per hour, the sorting of every required sequence of cards according to the analysis desired. A file compartment and a thirteen-space surplus compartment (with a capacity of about 550 cards) are adjacent to every row of cards (9-0, 11 and 12). The pile case on the card conveyor accommodates approximately 900 cards. If certain figures should be eliminated during a sorting operation, this can be achieved by means of an available splitting switch. The fundamental equipment of sorters with the so-called "account tracing device" is a further technical improvement which considerably increases the possibility of applying sorters. By means of this mechanism it is possible to provide punch cards with certain control holes in the pile no 11. For instance, it is possible to sort out inventory cards when making material accounting if these cards are not followed by any other moving cards. A delayed turn-off of the machine at the normal passing rate of cards, safety devices for a fast shut-off in case of jamming, the presence of a meter indicating the number of cards running through, as well as a compartment meter (as optional equipment) are some further improvements of sorters.

In addition, a new electronically operated sorter type 432 EL, with a maximum performance of 60,000 sorting operations per hour, is manufactured by the Office Machines Factory at Sommerda; in its basic design it is similar to an electric-mechanically operated sorter.

4. Tabulator Machine Type 401 (Picture 4)

Analyzing sorted punch cards is done by the numerical tabulator machine type 401, which represents the central point of the entire punch card technique. The maximum capacity of the machine is 9000 cards per hour in both single and mass operations. The great computing capacity, a total of 204 positions, is made by seventeen twelve-digit meters; when

using all the machine's mechanisms, additions, subtractions, and balancing operations can be done both vertically and horizontally, which means processing directly both positive and negative values. Before starting any computing operation, an automatic zero control must be done on all meters which function for separate programs.

For copying terms and values, the machine is provided with a 100-digit printing mechanism with an in between space of 2.6 mm. These 100 places are divisible at will during programming and can be switched to any combination of places. In addition, every place outside the figure 0-9 contains five more symbols for identification of positive amounts, i.e., of negative single positions. A favorable format can be achieved in this way. The maximum width of the form on the writing carriage is 460 mm, allowing a lateral shifting of up to 200 mm.

The available 24-digit group control can be divided into five groups in an arbitrary number of places. Twenty-two 6-digit and three 2-digit control mechanisms, thirteen auxiliary devices and fifteen 6-digit writing relays allow, in coöperation with nine possible intermediate gear shiftings, which can run in any sequence, a joint operation of all single aggregates and an automatic running of programs shaped so extensively that the tabulator machine is able to solve practically every task imposed on this machine group.

The programming panel (Picture 5), with its 3000 plug-in sockets, combines in itself all elements of the machine which are to be connected during the programming. The coupling itself is made by means of switch cords. Every tabulator machine is provided with five program panels which can easily be replaced when changing programs.

Besides the space switching (1-, 2-, and 3-space) thus far made possible, the tabulator machine type 401 is now provided with an additional depressing key which enables a mechanical progression of paper of any size. A mechanism for limiting positions by means of one of the meters in the machine was introduced as a further improvement.

5. Motorblock-Summary Punch Machine Type 6152

The steering mechanism of this machine, a unit in itself, can first be put into operation only by means of an exchangeable programming panel in the tabulator machine. The combination of both machines enables condensing onto summary cards a large volume of card material for later analyses in any desired form. The delivery of terms and values punched into summary cards follows parallel to and simultaneous with the recording of group amounts in the tabulator machine without decreasing its performance. The functional interdependence of both machines (start-stop principle) ensures an automatic stop of the tabulator machine when an obvious jamming occurs, i.e., when the supply box of cards is empty, when the box for piling cards is overcrowded, and the like.

6. Electronic Computer "Robotron" ASM 18 (see Technische Gemeinschaft 7 1959, vol 11, p 11)

This computer was designed essentially as an additional element for such an electric-mechanically operated card punch machine as the tabulator machine, card doppler, and summary punch machine. In connection with the tabulator machine, this combination serves as a device for both receiving and delivery operations. The eighteen available computing spaces can be used for making additions, subtractions, and multiplications, without any decrease in the performance of the tabulator machine, as follows:

	Capacity
a . b = c	10 . 8 places,
a . b + c = d	5 . 4 + 5 places,
a + b . c = d	5 + 5 . 4 places and,
1 . b . c = d	5 . 5 . 8 places.

7. Electronic Calculating Punch Machine ES 24 (Picture 6)

The electronic calculating punch machine ES 24 should be considered as a combination of three devices. An extended special design of the electronic sorter type 432, the EL, improved by two 80-digit touching sets of brushes and a switch board, an electronic computer, and a delivery printer, Ascota, Class 112, are all electrically intereonnected by means of a cable. There are two 12-digit meters in the computing part of the electronic calculating punch machine; these can be used separately and parallelly for balancing purposes. They can also be combined in a 24-digit meter for making additions.

The performance of the electronic calculating punch machine amounts to 42,000 cards per hour. It is possible to make normal sorting operations while the machine carries out balancing. Furthermore, large reference figures up to eight places can be chosen and balanced during a single sorting operation. The programming panel found on both the sorter and the electronic computer offers the possibility of selecting any desired column or punching field in the described form.

EAST GERMANY

SUBSTITUTES FOR LINSEED OIL IN PAINTS

[Following is the translation of an article by Klingner in Chemie Rundschau (Chemistry Review), Vol III, No 6, Leipzig, 10 February 1961, page 5.]

Production output can easily be expressed in dollars and cents, in tons, in raise of labor productivity etc. and thus is easily understood by everyone. It is more difficult, however, to express research and development projects in the same terms.

Extensive research and development is performed in the paint and varnish industry. One of the research projects carried out at the VEB Paint and Varnish Factory in Leipzig is the substitution of linssed oil by other oils of vegetable origin. What is the purpose of this project? Why should other oils be substituted for linseed oil, and in what way can this be done? For many years linseed oil has been one of the most important raw materials of the paint and varnish industry. On the basis of its chemical structure (i.e. the advantageous distribution of the more or less heavily unsaturated fatty acids in the linseed oil molecule), linseed oil helps to form paint films which fulfill all the requirements of a good paint, e.g. good drying power, gloss, weather resistance, etc.

Unfortunately, however, by far not enough linseed oil can be grown in East Germany to fulfill the demand of the whole paint and varnish industry. This shortage of linseed oil in due not only to the unavailability of land to grow it, but it is also due to weather and climate conditions. We are, therefore, forced to import linseed oil or the seed. The most important export countries for linseed oil are Argentina, the US, and India -- all countries with capitalistic economic systems. For these reasons there have been interruptions in the supply of linseed oil to the paint and varnish industry; this has resulted in the global theme "oil exchange" in 1956.

Linseed oil can be substituted in two ways in paints. One way is to use a pure synthetic binder and a second way is to use other oils of vegetable origin which can be supplied in sufficient quantities from friendly countries. These other oils of vegetable origin should be oils which can be altered by chemical conversion so as to exhibit the most important properties of linseed oil, especially its good drying properties. The investigation of the possibilities of substituting other oils for linseed oil in paints and varnishes is the purpose of these research projects.

SUBSTITUTION OF LINSEED OIL BY THE USE OF POLYVINYL-ACETATE LATEX PAINTS

In order to solve the problem by substituting synthetic binders,

the new watery plastic dispersions, which have been offered by the chemical raw products industry, paints could be formulated which in many areas of application were full substitutes for the paints in which linseed oil had been used. These PVA latex paints are now used where earlier oil paints were often used. The PVA latex paints also have one advantage over the oil paints in that they can be thinned with water, rather than with an expensive solvent.

SUBSTITUTION OF LINSEED OIL BY THE ESTERIFICATION OR OXIDATION OF HALF-DRYING OILS

Much more work was done in the chemical conversion of other oils of plant origin. There are at our disposal some so-called half drying oils, mainly sunflower oil and soy bean oil, which can be supplied to us from other countries, especially the Soviet Union. These oils, however, do not dry completely because of their chemical composition, so that no useful paints can be produced with them. Therefore chemical means have to be resorted to in order to alter the oils in such a way that they exhibit useful drying properties in paints. This can be accomplished in several ways. One way is to esterify the fatty acids in these oils with an alcohol like pentaerythritol, which produces the artificial oils which, in contrast with the half-drying oils, can be polymerized easily to stable oil and also exhibit useful drying properties. The half-drying oils can also be oxidized with air oxygen by means of bubbles. Afterwards the water is removed with a suitable catalyst. Double bonds appear in the molecule which enhance the drying powers.

SUBSTITUTION OF LINSEED OIL BY ISOMERIZATION

A third possibility on which research is being done is isomerization. By moving around the double bonds in the molecule the drying power ofthe half-drying oils can be improved to such an extent that they can be used in place of linseed oil in paints. Besides these three main directions many other ways to solve the problem have been suggested; some of these did not lead to satisfactory results. It is expected that the method for the production of penta-oils and the dehydrated oils will be applied in paint production some time this year; in the isomerization process, however, still more research will have to be done before the method can be applied in industry.

10,570

EAST GERMANY

VISCOSE RAYON FROM PREMNITZ

[Following is the translation of an unsigned article in Chemie Rundschau (Chemistry Review), Vol III, No 5, Leipzig, 3 February 1961, page 2.]

The production of rayon has now been started in the Friedrich Engels chemical fiber works in Premnitz. This is a result of a socialist effort of the workers under the leadership of engineer Wilhelm Seidl. The viscose rayon is produced from the waste materials of the spinning mill and has a very high quality. Until now, rayon, which is used for wall drapings, handbags, lampshades, and other everyday commodities, had to be imported from the capitalist countries.

Since there was a very strong demand for this fiber, the socilist workers' community has sought new ways to raise production. For the production of viscose rayon they have succeeded in using an old spinning machine that was ready to be scrapped. Through the use of this machine, four working steps have been reduced to one: this machine now spins, deacidifies, dries and spools the bast fibers. The production of rayon fiber is now to be about 70 tons per year. The workers' community is also busy producing spun dyed rayon in order to take some of the work-load from the dye industry.

10,570

EAST GERMANY

SOCIALIST RESEARCH HELPS DIMINISH FOREIGN EXCHANGE WITH THE WEST

[Following is the translation of an unsigned article in Chemie Rundschau (Chemistry Review), Vol III, No 5, Leipzig, 3 February 1961, page 2.]

After years of intensive research, a cellulose acetate has been produced for the first time in the GDR through the efforts of the members of the technical-scientific intelligence team at the photomechanical works in Koepenick, together with their colleagues in the chemical factory at Finowtal and the AGFA Wolfen works. This raw material, which is now prepared from cotton in the GDR, serves as a base product for films.

After good results had been obtained in the application of the acetate in the photochemical works at Koepenick, the AGFA Wolfen works have also started to produce this highly valuable raw material. The acetate is used primarily in the production of X-ray film; however, the chemical factory in Finowtal expects the Koepenick and Wolfen works to produce roll film, 35 mm film and motion picture film sometime this year. Several people and companies have contributed greatly in the development andtesting of this cellulose acetate, now produced in the GDR for the first time; Dr Werner Eggert and his assistant Reinold Vogel, the film factory in Koepenick, and Dr Hans Lapp from the film factory AGFA Wolfen, who is presently the production manager in the chemical works at Finowtal, have helped greatly to make the production of this acetate possible. Dr Eggert reported in a press conference that 1.5 tons daily of the acetate from Finowtal run through some of the modified machines at his plant. He also said: "We have tried for years to become independent of imports from the West; therefore, we are happy about this success in which all of us share. Now we shall be able to deliver it punctually and continuously; this will greatly raise our esteem in the foreign cntries."

The photochemical works in Koepenick export 50% of their valuable products to India, Portugal, Cuba, Greece, Columbia, Venezuela, Argentina, the UAR, South Africa, Turkey, and to the socialist countries.

10,570

EAST GERMANY

A TEXTILE SCHOOL FOR RESEARCH IN CHEMISTRY

[Following is the translation of an unsigned article in Chemie Rundschau (Chemistry Review), Vol III, No 5, Leipzig, 3 February 1961, page 4.]

The establishment of a textile school with a special department for chemical fiber research and textile refining is planned for the coming years at Schwarza, near Rudolstadt, a center of the artificial fiber industry of the GDR. With this new chool, the institute for textile technology of chemical fibers (which has been in existance for about five years) will receive research and development equipment which will be used to produce a better quality of synthetic fibers.

The institute at Schwarza, with its 300 co-workers, has established itself already as a scientific center for the synthetic fiber industry in the GDR and its socialist neighbors. During the last year good results were obtained by 28 socialist research communities in raising the textile quality as well as in the mechanization and automation of textile testing. This year 1.7 million German east marks are at the disposal of the institute for similar purposes. To begin, work shall be done mainly on polyamid fibers and polyamid silk.

One of the greatest successes of the institute was the development of profiled, synthetic, and hollow fibers which are superior in their very low weight, high padding qualities, efficient use as filling materials, and their excellent heat insulating capacities. Engineer Bolland, the initiator of this development, was honored for his achievements with a medal from the technical high school at Prague at an international symposium in that city.

10,570

NEW MACHINES FOR THE MANUFACTURE OF PLASTICS IN THE GDR

[Following is the translation of an unsigned article in Chemie Rundschau (Chemistry Review), Vol III, No 5, Leipzig, 3 February 1961, page 2.]

New machines for the manufacture of plastics have been developed in a community effort by the VEB Press Works in Freital and shall be exhibited for the first time at the Leipzig Spring Fair this year. With the development of these machines the Freital works have caught up in the development of modern machinery for the manufacture of plastics and, being no longer behind, have risen almost to the world level.

One of the new machines is an automatic spray-and-mold machine which can produce plastic objects up to a weight of 800 grams. The die of this new machine works at a pressure of 400 tons. This automatic machine is one of the newest in this field of machinery. We should also mention in this connection another new machine which utilizes a worm drive to compress and mix the plastic mass before it is carried on.

With these new machines, labor productivity has risen more than 80%; and 60 kilograms of polyethylene products per hour can now be produced, while machines of the same dimensions and working with the same pistons produce only twelve kilograms per hour. In 1961 the production and building of this new automatic machine will begin on a large scale. Another new machine at this plant which will also be produced on a large scale sometime later this year is a spray-and-mold machine with a closing power of 250 tons.

10,570

EAST GERMANY

REDUCTION OF OCCUPATIONAL RANKS IN CHEMISTRY

[Following is the translation of an article by Peter Seifert in Chemie Rundschau (Chemistry Review), Vol III, No. 6, Leipzig, 10 February 1961, page 5.]

At the Chemical Conference in November of 1958 the important questions of professional instruction and qualifications of technicians were discussed. Since this time instructors in the professional schools, representatives from the factories and state officials have given a lot of thought to improvement of the professional education of specialists and skilled workers in the chemical industry.

What have the changes in the education been? In our register of different occupations we have had till now 64 occupational ranks in chemistry; these have now been reduced to only 19. In so doing the progressive development of our chemical industry for the coming years were taken into consideration. The following is a list of some of these new occupational ranks which are of special importance in our economic system: Organic specialist in chemistry, inorganic specialist in chemistry, specialist in chemical fibers, specialist in photo-chemistry, specialist for thermochemistry, chemical laboratory assistant, paint and varnish technician, rubber specialist, and expert on technical coal. In order to enter any of these occupational ranks it is necessary to graduate from a polytechnic high school consisting of ten grades. After finishing this school it is necessary to be a special trainee, or apprentice, for two years in the industry. Up to this time there had been different educational courses for the wage brackets III, IV, and V, but in this new classification this is no longer the case. Now everyone in the field of chemistry shall have the knowledge and know-how of a specialist in the number V bracket.

The overall education for all these ranks has been made more versatile. In his first training year after graduation, the young person receives an overall education on the job, and in his second year he receives training in his occupational specialty. For the trainees in chemistry the first training year serves to give the young person knowledge and experience in the areas of general chemistry, metal processing, electrical technology and measurements and controls. This way the young person is supposed to learn such analyses and methods as he will later need for the supervision of production. The young trainee is also required to repair pipe lines in special training areas so that he can be used as a specialist later if a similar job has to be done. In his second training year he learns how the production departments operate. This way the young trainee works right in production and is coached directly by chemistry specialists and engineers. In the last three months of their second training year the trainees work

in the production departments into which they will be placed later as specialists; this is their occupational specialty in which they have to pass a professional examination. After having passed this professional examination, the young person is ready to take over all the responsibilities of a specialist in chemistry and work with and regulate the many complicated chemical reactions. These young people can, if they like, study directly, by correspondence or at night for their master's or engineer's degree.

10,570

EAST GERMANY -- ECONOMIC BRIEFS

STANDARDIZATION IN THE POLYGRAPH INDUSTRY.

The complete standardization scheme in the polygraph industry was fulfilled 100% on 23 November 1960. A reason for this 100% completion is the good leadership in that branch, extending from the Government Planning Commission through the VVB down to the plants.

A plant check conducted by the Government Planning Commission proved that the New Technology Plan, 1961 has been solved for all working places. In addition, the VVB is conducting for all technical leaders an eight-day training course in the New Technology Plan.
(Berlin, Standardisierung, Vol 7, No 2, January 1961, page 1/97)

SAVING FOREIGN EXCHANGE BY DOMESTIC PRODUCTION.

Technicians and workers of the VEB Shipbuilders will save considerable foreign exchange by the use of artificial fabrics manufactured in the GDR instead of imported plywood. For doors for ships alone, a yearly saving of a least 10.000 DM can be made. First experiments with plastics from VEB industry were so successful that serial production will begin in 1961. The use of colored artificial fabrics for tables and other ship furnishings will lead to savings of foreign exchange.

The basis for these successes is above all the standardization of ship furnishings which has been extended to all GDR shipyards. A yearly profit of DM 100.000 is expected from the so far introduced standards which will be fully in effect in 1962. There are for instance, 12 instead of the former 100 door sizes. Standards for mouldings have resulted in a yearly saving in wood in the amount of over DM 32.000. The VEB standardization program, which will be completed in 1961, ranges from bunks, couches, cabin tables to bookshelves and phone tables.
(Berlin, Standardisierung, vol 7, No 2, January 1961, page 1/97)

10,511

HUNGARY

NEW PLASTICS IN CORROSION PROTECTION

/Following is the translation of an article by Bela Kiss in Gepgyartas technologia, Vol 1, No 3, Budapest, 1961, pages 83-86./

Synthetic materials (plastics) are definitely superior to classic materials in their corrosion-resistance properties. It is only natural that their significance as an anti-corrosive material keeps growing.

Plastics are used in two ways against corrosion. One way is to cover corrodible materials, thus defending them against harmful effects. The other way is to use plastics in themselves. I will now discuss the first method of use.

The defenses against corrosion can be classified according to the method by which the plastic coating was made. There are six methods of making coatings:

1. Coating by solution
2. Coating by dispersion
3. Melting methods
4. Post-solidification of liquid plastics
5. Foil coatings
6. Panel coatings

1. Coating from solution

Coating by solution belongs to the lacquer industry. In general, the thermosetting plastics (or synthetic resins) developed for the lacquer industry play the major role in this group because the giant molecules that become plastic with heating have only a very limited solubility, and the coat made of them is very thin, even if very high viscosities are involved. I do not want to deal here with the materials belonging to the lacquer industry. I must mention, however, a field which is becoming ever more important. This is the spread of the elastomer (synthetic rubber) materials. Vulcanized synthetic rubber coatings satisfy the demands for high strength and elasticity. They can thus follow the motion of the metals they cover, whether heat expansion or motion brought about by mechanical causes. The wear resistance of these materials is also very good, and they are among the best corrosion-defense materials.

Two kinds of synthetic rubber can be used for coating against corrosion. The first is polychloroprene (such as Du Pont's Neoprene

and Bayer's Perbunan C); the second is chlorsulfonated polyethylene, such as Du Pont's Hypalon. Neoprene was the material commonly used, but it is now being replaced by Hypalon. There is no significant difference between the materials in corrosion resistance, but Neoprene is too cumbersome to dissolve (usually kneading mixers must be used). However, Hypalon dissolves easily. Hypalon can also be combined with other plastics, and this facilitates "custom-made" combinations for any use.

Polychloroprene (Neoprene) is being developed by the Technical Rubber Factory. I worked out a few chlorsulfonated polyethylene (Hypalon)-based coating combinations in the Plastics Research Institute.

These coatings are not cheap, and cannot be used for general anti-corrosive purposes. They should be used for metal protection where other materials fail (due to corrosive ambient, weather, etc.). Such uses are found in the textile industry, in galvanizing shops, refrigeration, etc. Coating can be done with general painting techniques, after such preparatory steps as rustproofing. At room temperatures the vulcanizing mixtures are made of two components which should be mixed a few minutes before application. Their storage period is only a few weeks after they are mixed. The warm vulcanization (at 60-120°) mixtures consist of only one solution, the accelerator having been already mixed in. Chlorsulfonated polyethylene coatings can be made in any color. Although the method is fully developed, industrial application has not yet taken place.

2. Coating by dispersion

Recently dispersions have been made for coating purposes. The plastic is dispersed in very small globules in a dispersing agent (which does not dissolve the material). Dispersions have the following very great advantages over solutions: the dry material content of the dispersion is much higher than that of the solutions, and yet their viscosity can be kept low. Dispersions which have a 50-60% dry material content can be made with viscosities only slightly higher than that of water. Many plastics which cannot be brought into solution, or only very cumbersomely, can be dispersed. The dispersions are not toxic and do not constitute a fire hazard, due to the fact that water is the dispersing agent in most cases.

Dispersions, however, have the following drawbacks. Materials which form poor films must receive heat treatment to melt them into a coherent film. Unfortunately, most of the excellent anticorrosive plastics belong to this group. Since the dispersions contain water, care must be taken to prevent metal rusting during rustproofing.

In summation, dispersions which show no advantages over other coating processes are not yet considered for use, in spite of their nontoxicity and nonflammability. Those dispersions, however, that can apply plastics which cannot be applied by any other method

are enjoying ever wider applications in industry.

Such plastics are mainly the fluorinated plastics, the hard (or low-pressure) polyethylene (PE), and, to a lesser extent, normal PE. For domestic purposes, fluorinated plastics are out of the question (because they cannot be obtained at all, or only with great difficulty).

High-density PE dispersion, however, must be given serious consideration. This PE is also called low-pressure, hard, or heat-resistant PE, as opposed to the softer, less dense PE which is made by the high-pressure process. Although the former material cannot be dissolved, it can be melted; however, this process entails certain limitations, since its melting point is so high that working this temperature causes a serious oxidative breakdown. Flamecoating cannot be used for the same reason. The melt-on method can be used if enough care is taken, but the coating is inferior to that received from other methods which use no heat. Dispersion hence seems to be the ideal method; in foreign journals increasingly more articles are published on the subject. Domestic experiments have already started.

PE can be dispersed both in polar and in apolar agents. Since PE is strongly hydrophobic, pure water cannot be used. The systems are usually alcohol-water systems. While they constitute only a minor fire hazard and have a low toxicity, the metals must be protected from rusting during coating. Apolar agents do not attack the metal, but they pose a more serious fire and toxic hazard. Dispersions contain 35-45% PE. After the usual de-rusting, the dispersion can be brushed on, spray-coated, or immersed. Since PE forms only a poor film, we do not get a coherent layer after drying. Heat treatment follows, which means keeping the object at 180-240 C° for 10-60 minutes. This is less time than needed for the melt-on method. The length of treatment depends on the object, because materials having a large heat capacity carry a great part of the heat away and hence need more time to get a homogeneously melted film.

Although melting-on is the ideal method for normal PE coatings, dispersion begins to gain here, too. Normal PE dispersions are used when even the thinnest layer that can be obtained by melting-on (approx 0.5 mm) is too thick. Films made by dispersion can be as thin as 0.05 mm. Normal PE dispersions are generally expensive, because the PE must be ground before dispersing. (Low-pressure PE is manufactured in powdered form; hence, no grinding is needed.)

3. Melting methods

Actually, we should speak only of flash-melting, for the melting takes place only at the moment of coating. There are two methods known: flamecoating and melting-on (cf. Gep, 1959). Flamecoating should be used only when no other method is possible.

Here the plastics are very much exposed to heat; furthermore, there are no accurate technological methods for this process.

Melting-on, however, has great significance. Coatings obtained this way insulate (up to 2000 volts), are hygienic (in plants, public places, at home) and attractive, besides providing corrosion resistance. The metal object is heated to a temperature above the melting point of the plastic and is immersed into the plastic powder. When an inner coating is needed, the powder is poured into the warm hollow. Loosening the powder can be done mechanically (small sizes) or by floating (large sizes). In the latter system the powder is in a tank with a porous bottom. The air coming through the pores keeps the powder in a loose condition.

Some of the advantages of plastic coats over galvanized or painted ones are listed below. The surface need be cleaned only of rust and oil; labor-demanding polishing is not needed. Plastic coats can thus be used on practically raw moldings; only the rough burr need be eliminated and only the larger holes welded. Melting-on has only one step, which means not only that it is more productive than painting or galvanization but also that it lowers the processing time of the objects. Sources of error in the finishing step greatly diminish.

Of course, this does not mean that plastics are superior always and everywhere to painting or galvanization. Where electric insulation is needed, plastics are indispensible. The melt-on method is limited mostly by the size of the objects; only objects which can be coated with this process can be put into the preheating furnace and moved by hand or machines. Immersion also makes partial coating difficult, and it entails material losses. Thin objects (panels, etc.) should not be coated by this method because they have a low heat capacity and hence require too high preheating temperatures.

Table 1 (see following page) gives a good summary of the melt-on method. Several machine factories already use this method, which was developed by our Institute. All inquiries about the method should be addressed to the author, Plastics Research Institute, Budapest XIV.

Methods 4-6 will be described in the next issue of this journal.

Illustration Captions:

Illustration 1. Steps of the melting-on process: a) spring to be coated; b) preheating in furnace; c) immersion in plastic powder; d) the powder melts on the metal surface; e) shiny surfaced end product.

Illustration 2. Various parts and tools coated with melted-on plastics.

Illustration 3. Doorhandles coated with melted-on plastic.

Table 1

	Low-density Polyethylene	High-density Polyethylene	Polyamide	PVC	Cellulose Acetobutyrate
Heat Resistance, C°	60-100	70-120	120	60	100
Cold Resistance, C°	-60	-50	-30	-20	-40
Melting (or softening) Point, C°	110	130	215	70-160	200
Preheating Temperature, C°	250-300	280-320	300-380	200-250	250-350
Acid Resistance	Very good	Very good	Poor	Good	Weak
Alkali Resistance	Very good	Very good	Weak	Good	Medium
Solvent Resistance	Poor	Poor	Very good	Weak	Poor
Oil Resistance	Slight	Medium	Very good	Good	Good
Water absorbtion, % in 24 hours	0	0.3	7	0.2	3
Physiological Effect	Excellent	Excellent	Excellent	Satisfactory	Satisfactory
Electrical Insulation	Very Good	Very good	Satisfactory	Good	Good
Workability	Very good	Medium	Weak	Good	Good
Surface Gloss	Silky	Matte	Matte (polishable)	Shiny	Shiny
Uses besides Corrosion protection:					
Protection against Wear	Medium	Medium	Very good	Medium	Medium
Protection against Blows	Good	Good	Medium	Good	Good
Protection against Bending	Very good	Good	Medium	Very good	Good
Electrical Insulation	Very good	Good	Medium	Good	Good
Decorative Effect	Good	Slight	Medium	Very good	Very good

HUNGARY

POSSIBILITIES OF HEAT POWER CONSERVATION IN THE CHEMICAL INDUSTRY

/Following is the translation of an article by Gy. Barta in Ipari Energiagazdalkodas (Industrial Energy Economy), Vol II, No 6, June 1961, pages 121-126./

New ways of saving heat energy are being discovered with the introduction of technological innovations in the chemical industry; sometimes the quantity saved is quite large. The possibilities are realized in some already existing chemical plants and plants under reconstruction (utilization of waste heat, recovering heat by cooling, in exothermic processes, etc.). However, other possibilities have not even reached the planning stage; they are accompanying new technological processes for which experimental data are not yet available, even abroad, or their introduction is so costly that there are no funds available for investment. The planning branch of the chemical industry makes considerable effort to introduce technological processes which are economical from the viewpoint of power; currently, the planning of a number of new plants is underway, with special emphasis on this problem. For example, the planned production of sulfuric acid, using original sulfur as the base and operating with fluidization furnaces, and the production of artificial gas by decomposition from natural gas.

The scope of this article is limited to the discussion of steam, its generation and utilization in the plants of the chemical industry; the treatment will be general and uniform.

Since the consumption of power in our chemical industry (in some branches more than in others) is considerable, a thorough examination of the problems involved seems warranted. A few statistical data, compiled for this particular purpose, will convince anyone of the significance of this problem; they will convince even those persons who are inclined to consider the cost of power to be of minor weight in the production budget; indeed, it may seem so in relation to the high production figures. According to actual figures for the first quarter 1959, the ratio of power costs to total production figures was as follows for the various industries:

Heavy chemical industry	26 percent
Organic chemical industry	8.35 percent
Petroleum industry	9.05 percent

Of the total power consumption, thermal power accounts for 50 percent; in some cases,even more.

It is easy to see that heat power consumption is far from being an insignificant item in the total production budget of factories, and that the rational curtailment of this expense may have a considerable effect on the production cost of these products.

As indicated by the above statistical data, the chemical industry has a high demand for heat power; I therefore propose to discuss the more important aspects of heat power production and consumption.

Based on recent appraisals of the status of power economy in the rubber, synthetic materials, drug, paint, petroleum and coal processing, as well as inorganic chemical industries, a number of general conclusions may be drawn; these conclusions may be meaningful not only for the specialists in the field but also may impart the impetus to other fields to conduct similar investigations to weed out such deficiencies in power economy as may still exist. A few data will be presented to illustrate the significance of possibilities of energy saving:

The total annual steam production of the above-mentioned industries is 2,900,000 tons. The total amount of condensates returned to the boiler plants is 256,000 tons/year, or only 9 percent of the generated steam. Since the generated steam figure given above includes the quantities used for heating buildings and water, it would seem that the industry has solved the reutilization of condensates from these latter heating systems only.

When we examine the existing boiler park from the point of view of average life, unit efficiency, heating system, and operating pressure, the following picture presents itself:

Boiler park distribution according to life in the chemical industry:

Boilers age 1 to 10	23 percent
Boilers age 10 to 20	8 percent
Boilers age 20 to 30	19 percent
Boilers age 30 to 35	28 percent
Boilers over 50 years	22 percent

The above table indicates that 22 percent of the functioning boilers is over 50 years old; in other words, these were installed around the turn of the century. The majority of these boilers are hand fuelled and require quality coals. Even the few mechanically fuelled boilers are operating with quality coals The majority of the boilers is 30 to35 years old, a possible consequence of the increased industrial potential created by World War I. These boilers are also designed predominantly to use quality coal. The proportion of boilers 20 years and over indicates the sluggish industrial development during the Horthy era. The number of boilers installed during the past ten years is characteristically high, an index of the tremendous industrial expansion of our socialism-building country.

Boiler park distribution according to capacity in the chemical industry

One t/hour	40 percent
One to three t/hour	17 percent
Three to five t/hour	22.4 percent
Five to 10 t/hour	10 percent
Ten to 25 t/hour	10 percent
Twentyfive to 50 t/h	0.6 percent

This distribution points up the prevalence of units with less than one t/hour capacity. The deduction may therefore be made that, with a few

exceptions, the plants of the chemical industry are small and widely scattered. This is especially true for the plants producing oxygen and acetylene, dyes, paints, and varnishes. of course, the small boilers are built, almost without exception, for manual fuelling, and they also are the oldest. No boiler used in the chemical industry exceeds a capacity of 50 t/hour; thus even the larger plants have relatively small boiler units, a consequence of the cautious and haphazard quality of industrial development in the past.

Boiler distribution according to heating systems in the chemical industry

Manual fuelling	43 percent
Chain grid type	11.5 percent
Travelling grid	16.5 percent
Oil fuelling	24.2 percent
Other fuel	4.6 percent

The above findings reinforce the previous deduction, namely that the smallest and oldest boilers are hand fuelled. The proportion of boilers using oil fuel is relatively high, a result of the material being available in petroleum processing plants. The ratio of modern boilers is less than 5 percent, indicating the lack of initiative in exploiting the possibilities of modernized heating systems.

Boiler distribution according to operating pressure in the chemical industry

Six atm	41 percent
Six to 12 atm	44 percent
Twelve to 25 atm	5 percent
Twentyfive to 40 atm	10 percent

This distribution further reveals the high proportion of outdated boilers in use which obviously are not the high-pressure variety. Also, due to the necessity of low-capacity units, no provisions could be made to couple steam supply with the generation of electricity. The relatively high number of boilers between 6 and 12atm may be explained by similar reasons. Part of the 12, 25, and 40 atm boilers operate with back pressure or with diverting condensing turbines.

In order to render this sketchy survey more complete, it is necessary to shed some light on the built-in electric capacity at the disposal of plants operating coupled steam and electricity generating plants and on the amount of steam obtainable by deliberate pressure reduction. The available 21 MW capacity, calculated on the basis of the approximate average specific value of 15 Kg steam/KW hour and an average of 5000 working hours per year, allows for an output of 1,575,000 tons of steam, or 54.3 percent of the total annual steam output. This value may be considered relatively high, particularly in view of the above-discussed distribution of the boiler park with regard to pressure; however, it points up at the minimal amount of generated electric power.

Finally -- again in the interest of completeness -- it should be mentioned that plants utilize approximately 385,000 tons of steam per year from remote heat supply; 228,000 tons are obtained through back-pressure

steam turbines, and 157,000 tons are transmitted at boiler pressure.

Thus, the steam supply coupled with generation of electricity constitutes 55.2 per cent of the entire demand, while the amount of steam used from remote heat supplies accounts for 11.7 per cent of the total requirement.

As shown, the heat energy demand of the chemical plants under scrutiny is very high, and consequently an investigation into the degree of boiler efficiency of the boiler park seemed justified. Naturally, I was forced to work with a number of hypotheses in the calculation of the realistic average efficiency. According to my results, the overall average index of efficiency in the chemical industry is 69 percent. Broken down into the various branches of the industry, the indexes are as follows: 69.5 in the organic chemical industry 62.5 in the rubber industry 45 in the paint and dye industry and 71 percent in the inorganic chemical industry.

Under prevailing domestic conditions, these values are believed to be quite good. If, however, we consider the fact that, based on average boiler efficiency, the amount of coal used per year is 618,000 tons, at 3,350 kcal/kg normal thermal value, and the amount of fuel oil burned is 133,000 tons per year, it seems that an intensive study of the possibilities of improving efficiency indexes is time well spent. For it is a proven fact that each per cent improvement constitutes a saving of 9,000 tons of coal and 1,500 tons of fuel oil per year; the saving expressed in money (including the decrease in the expense of mining investments and transportation) is 6,000,000 forints for coal and 650,000 forints for oil, annually.

The question remains as to the methods to be used to achieve these savings. Looking at the data quoted regarding the boiler park, we are appalled by the small number of boilers equipped with modern heating systems (see under heading "Other heating systems") and the large number of manually operated boilers. The obvious solution then must be approached from this direction.

The term "modernized heating system" is being used for equipment bringing about nominal or higher output, accompanied by increased thermal efficiency, in chain or travelling grid-type boilers. Several such apparatuses are known, and it is not my intention to discuss these here. Wherever used, they have proven both themselves and the fact that their installation is economical. The reason for using them to such a small extent in the chemical industry may be, the one hand, that the overcrowding boiler houses poses a difficult problem of layout; on the other hand, the outdated boilers would probably not tolerate the increased load over an extended period of time. Since there is little hope for a change in this respect in the future, it may be assumed that there is little chance to modernize the chain and traveling grid-type boilers. Supporting this conclusion is the fact that neither system offers a possibility for increasing boiler pressure and superheating steam; in other words, for the introduction of electric energy generation, the latter being a supreme need in the people's economy.

Since the boiler park distribution regarding output is also unsatisfactory, the solution seems to in a gradual replacement by new units. The capacity and steam specifications of the new units are selected according to the demands of small and medium sized industrial power plants.

Calculations based on a variety of situations indicate that the amortization period for such investments is rather short, even in the case of low-capacity (0.5 to 2 MW) power plants. For the future, this method seems to be the best for the reasons discussed above and also because of the modest space demands of modern boiler plants and the existing possibility of raising the light roof structures of boiler houses.

A year-round average boiler efficiency above 75 percent may be safely expected from these power plants, with consideration of the boiler efficiencies available.

A close examination of the prevailing conditions with regard to the numerous low-capacity boilers with manual heating indicates similar measures, although there are some additional factors here to influence decisions.

There are 30 chemical plants which are supplied by boilers with less than one ton/hour capacity. These plants belong to roughly four production profiles. This is indication that the many widely scattered plants are not economical from the viewpoint of production either. There are some initial efforts in the paint and varnish field, and in the drug and other fine chemicals production, to concentrate these small individual plants. Thus the small, maually operated boilers will become superfluous and the centralized plants will offer the possibility of installing units of higher capacity, or the demand will be satisfied from a central power plant.

Since, however, small units will always be needed in the above-mentioned branches and elsewhere, the gradual replacement of boilers in this bracket may also become necessary in some instances.

A few of the basic considerations with respect to boiler types to be evolved already emerge from the above investigations. These may be outlined as follows (with a brief explanation as to their necessity):

1. Three tons per hour maximum capacity boilers are to be designed with fuel oil heating, with 12 atm pressure. Reasons:

a) The best relative efficiency is to be achieved by oil heating in this capacity range;

b) the largest quantity coal would become availabe for other, mainly household, heating purposes;

c) Small plants utilizing this boiler type usually have the greatest difficulties with transportation and storing; transportation and storage of oil presents less problem;

d) Manually heated boilers require a relatively large number of service personnel;

e) Under favorable conditions, the proposed pressure level makes the installment of electricity generating systems (steam engine and generator) possible.

2. Development of a boiler type with five tons/hour capacity, equipped for both oil and coal fuel, generating 28 atm and 350 C^o steam, may be considered. This type is justified because:

a) Two to three units of this boiler type could economically satisfy the needs of many small and medium-sized plant;

b) Suitability for two kinds of fuel assures uninterruped operation in the fluctuating fuel situation of the country;

c) Steam specifications allow for the generation of electric power coupled with steam.

3. Development of a ten to fifteen tons/hour capacity boiler is necessary, one which generates 40 atm 450 C° steam. These would economically supply medium or large plants. I prefer not to suggest any particular heating system for these, as this would require more detailed investigation of the possibilities. These boilers would facilitate the operation of major power plants, while the steam specifications do not require the more costly and complicated methods of water preparation; they therefore are more economical also from the viewpoint of management.

Boilers of larger capacity and pressure are economical only in very large plants and find their most advantageous application in the large district heat-power plants. These boilers exceed the demands of the average industrial operation, and I would not venture even a tentative proposition in this respect.

I feel that the essential issues concerning the boilers themselves have been touched upon; I now propose to discuss the issue of water condensing economy, another important area of heat energy economy. I wish to preface my remarks by reminding the reader that a mere nine percent of the steam supplied is now being returned to the boiler plants for re-use in the chemical industry.

In the course of the investigation conducted in the different plants of the chemical industry, numerous possibilities, as yet unexploited, have been discovered. It was found that there is a widespread aversion to the use of condensed steam for heat input in direct heating units; even well-trained personnel are of the opinion that good heat transfer can be achieved only by a strong steam flow through the boiler. Due to this conviction the accepted practice is, even where the units are equipped with condenser leads and steam traps, to let the steam escape by lifting the trap float or by opening the detour lead. It is up to the plant engineers to gradually change these practices by the application of persuasion, instruction, and by displaying operation with a closed condense system.

The determination and gradual introduction of steam consumption norms, based on theorectical and experimental work, would help put an end to such wastes of steam energy. Modern production organization is unthinkable without scientifically evolved norms. Although most plants still lack the condense systems necessary for economical steam utilization, the domestically manufactured condensing vessels are also not quite up to par. However if we consider the cost of generating the steam thus wasted, as well as the cost of the lost condensing water, it is easy to see that the funds to be invested could be recovered within a very short time indeed. I can support this statement with the result of some calculations. For example: the Palma rubber factory would be able to save 270 tons of coal by a 40,000 forint investment, to be amortized in six months; a 700,000 forint investment in the Kobanyai Gyogyszerarugyar (Drug Manufacturing Co of Kobanya) could save 1334 tons of coal annually and the investment repaid in less than one year. These figures do not even include the

resulting reduction in steam consumption, as outlined above.

A thorough examination of the petroleum industry's steam consumption would be of the utmost importance. There are indications that the recovery of condensed water is not at all solved in this branch. Since in most cases the pollution of the water by oil can be reduced to a negligible amount by suitable equipment, and thus condensed water rendered suitable for re-use, this problem merits close attention; an overall annual cut of over 4 million forints in operating costs could be achieved. The issue is all the more important because many times the above figure could be saved in the new Dunai Finomito (Refinery on the Danube), now under construction. I realize that these figures may not seem too significant in relation to the production figures of the petroleum industry; however, it should be kept in mind that in our present fuel situation the saving of several thousand tons of fuel or crude oil cannot be overlooked; we are in no position to follow the example of countries possessing giant petroleum industries.

The gradual introduction of condensing economy could go hand in hand with the proposed boiler park reconstruction. A modernized boiler park would have more stringent requirements for the quality of feedwater. This way, every recovered cubic meter of water would save money toward investment in water softening plants; the savings in softening chemicals are not to be overlooked either. The significance of this may be appreciated better if we take into consideration that a one m^3/h capacity water softening plant (depending on the size and system) costs between 40 to 80 thousand forints and that average softening operation costs vary from one to three forints $/m^3$, including the cost of unsoftened water.

Instrumentation, another important factor in modern heat power economy, will be discussed briefly. The problem of instrumentation basically forms part of the problem of energy norms, discussed above. It must be admitted that the majority of the chemical plants are equipped with proper measuring instruments, necessary for the control of boiler operation, however , due to inadequate maintenance the instruments have become unreliable or liable to break down. Personnel cannot and do not trust them, and they do not exploit the advantage of instruments in their work. This is true nationally and is not restricted to the chemical industry. It is to be hoped that faith in domestic gauging instruments will increase as these products are sought and valued abroad.

Heat supply coupled with the generation of electricity is an important branch of power economy, both on the national and the individual plant levels. As already mentioned, over 50 percent of the steam supply of the chemical industry is affected. However, considering the fact that only ten percent of the existing boilers operate at pressures of 25 and above, and that the maximum boiler pressure is 33 atm, it becomes evident that there is still much to be done in the field of economical power generation, especially since these boilers are located in two or three plants. This aspect is also related to the gradual reconstruction of the boiler park; it is possible that the authorities in charge of power economy will find the proposed pressure ceiling of 40 atm too low. As for boiler pressure economy, it must be pointed out that the amortization

of such backpressure power plants for industrial purposes is over three years, even in favorable cases when existing low pressure boilers are available as reserves for the 40 atm boilers, Furthermore, in the cases examined the building investment was extremely low, due to local conditions. In industrial power plants the selection of boiler pressure level is not governed solely by the quantity of electricity to be generated. When the more complex planning and execution, the longer time needed for construction, and the high operational requirements are considered, it becomes obvious that the greatest circumspection is necessary in the selection of proper pressure levels.

Calculations show that about 29 million kw/year of electricity could be obtained by constructing new industrial power plants and by replacing old ones; and an additional saving could be achieved by making 36,500 tons of coal available annually for other purposes.

This amount could be increased significantly by the adoption of a proposition regarding the gradual replacement of the boiler park.

In addition to the areas discussed in detail above, I wish to touch upon a few others without which the examination of the possibilities of economy would be incomplete.

In the chemical industry there are many furnaces in use for a variety of purposes. With few exceptions, most of these have high-temperature flue gases which are now wasted, although they could be utilized in most instances at relatively low cost. Characteristic of the economy of waste-heat recovery is the fact that investments are amortized within a maximum of two years in all cases studied. Similar results are obtained in other industrial branches where furnace operation is frequent. The Hotechnikai Kutato Intezet (Institute for Thermal Research) has just completed a nationwide survey of furnace operation, and it is hoped that this will result in effective measures to improve efficiency.

The problem of drying must be mentioned. Drying, even with the best, most up-to-date apparatus, is an extremely low-efficiency operation. However, the present five to six percent efficiency is much worse than need be. Since drying in most cases is a particular technological phase, there is no way to set up general principles. The major objective here is to install continuous drying equipment wherver the circumstances allow it.

Of lesser economic significance is the installation of feedwater heaters, operated with waste heat, and equipment utilizing "lye" heat. In the chemical industry as a whole the absolute saving to be achieved is not too large, but such investments are repaid in about two to three months and are thus easily realizable from credits extended for production cost reduction.

I do not intend to devote here much discussion to the economy of heat supplies far away from heat power plants because the literature covers this extensively. I merely wish to point out that the efficiency of a power supply outside of a power plant's steam conduit reach needs to be studied in terms of the peculiar needs of the consumer plants.

So far I have failed to notice that these aspects were given due consideration. In my opinion, the investment planning of heat power plants should include a section devoted to the energy needs of the plants to be supplied, along with caloric calculations. Since a network of heat power plants is being developed, I hope that this issue will be given more attention in the future.

Finally, I wish to mention yet another possibility for economy, the utilization of the so-called technological waste heat for the operation of absorption cooling equipment; this possibilitiy is currently discussed semiofficially and is bound to be adopted in the future because of its high rate of efficiency. Its development must coincide with a plant's steam supply, and the capacity must be coordinated with the demands of the cold-storage industry. We could do pioneering work in this area, which may help the cold-storage industry to solve its storage-space difficulties.

My purpose in giving a brief, comprehensive survey of the tasks of the chemical industry in the field of heat power economy was to call the attention of the industry's workers to the increased exploitation of possibilities and to the significance of the profit to be gained by the people's economy.

Illustration Captions

Figure 1:
Steam receiving station of the Chemical Combine of Borsod.
The steam transformer seen in the photo supplies the cosumers with steam.

Figure 2:
In the La Mont boilers of the Pet Nitrogen Works, heat devived from burning ammonia is used to generate steam.

Figure 3:
Upright tube furnaces in the Petroleum Works of Zalaegeraszeg.

POLAND

PRODUCTION OF MARINE ENGINES IN THE H. CEGIELSKI PLANTS

/Following is the translation of an article by Engineers J. Kryszewski and A. Presz of the Metals Industry Plants H. Cegielski in Poznan in Przeglad Mechaniczny (Mechanical Review), No 9, Warsaw, 10 May 1961, pages 266-271./

The Polish shipbuilding industry, the development of which was particularly stressed in the postwar period, today occupies a prominent position among shipbuilding countries with regard to the quantity of units built, their size, and the quality of the work.

The yearly increasing production of ships in our shipyards, which ships until recently were equipped with imported engines, has now a base for building marine engines in domestic plants.

The greatest burden of this new production in the machine industry has been borne by the expanding H. Cegielski Metals Industry Plants in Poznan. After completion of expansion the H. Cegielski plants will assure to the shipyards delivery of main engines in the range from 3000 to 24,000 h.p. The planned development will make it possible to achieve in 1965 a yearly production capacity of 280,000 h.p. and 550,000 h.p. in 1975, thus placing the H. Cegielski plants in one of the top places among world producers of marine engines.

Beginning of Production

In 1956 the then Ministry of Machine Industry decided to localize the production of high power marine engines in the H. Cegielski plants in Poznan. The existing locomotive factory, whose tradition reached back to 1923, was converted to produce marine engines. It was decided that the factory should undertake the building of engines of the D55 type of native design as well as engines of the RSAD76 type, based on patents of the well-known Swiss firm Sulzer. In June 1956 a patent agreement was signed for RSAD76 engines with the Sulzer firm. From May to June 1957 the factory received design documentation which were made ready for production by September 1957.

The assembly of the first engine was completed at the end of August 1958, and plant tests were completed in November 1958 (Illustration 1.)

Concurrently with preparations for and mastering production of the 6RSAD76 engine, work was being done on the execution of the 3D55 experimental engine of Polish design. The building of this engine was

begun in July 1957 and it was experimentaly tested in April 1958. The results of one year's tests on the experimental stand made possible the preparation of the production of a nine cylinder prototype engine, the 9D55.

These are the historical dates of the beginning of a new page of production in the H. Cegielski plants in Poznan.

Machine Tools and Equipment of the Engine Factory

The large dimensions and great weight of the parts of marine engines have made it necessary to introduce entirely new technological processes of welding, machining and assembly, hitherto not applied or known in this country, and to adapt the machine tools and equipment to a new kind of production. The existing machines and equipment had to be exchanged for special machines and equipment. Partial description and illustration of some of the most interesting technological processes, machines and equipment will permit recognition of the problems of creating these new machines and equipment and their characteristics.

In large engines the welded parts comprise about 24% of the total weight of the engine. The main elements of the engine, such as base, stand, air containers, shields etc., are produced by welding sheet metal 5-50 mm thick. Thus the range of work of the welding department comprises such processes as drawing, burning, bending, putting these elements on special stands, welding, cooling and cleaning the parts after welding. The present method of hand welding by highly qualified welders will shortly be supplemented with automatic welding (Illustration 2).

A number of special machines permit many operations in one setup. The bases of the engines, weighing in the assembled state -- assembled from two parts -- of the 6RD76 about 45 tons, are at present machined on a combination planer-milling machine. This machine tool was redesigned and rebuilt, according to the guidelines of the H. Cegielski plants of Poznan, from a typical planer into a machine tool permitting, besides planing, also the operation of milling with milling cutters of large diameters. This rebuilding shortened the time of machining on this machine by about 35% (Illustration 3).

Machining and boring of the seats of the main bearings in the base takes place on a machine tool equipped with a special boring spindle; this machine tool was made by Rafamet according to the guidelines of the H. Cegielski plants (Illustration 4).

To machine the cylinder shafts weighting about 2.5 tons, two special machine tools are used. Surface machining (turning) is done on a special lathe of the TRB-160 type, especially built for the Engine Plant [division of the H. Cegielski plants]. This lathe has a taper attachment adapted for boring. This attachment is equipped with double eight-edged tool stands for outside machining each tool stand has a three-cutter tool head capable of being pulled out up to 3000 mm, and a tool stand for inside machining (photo 5).

The next operation on the cylinder shafts is on a vertical lathe, BZS-300 Schiess. This lathe permits the achievement of the tenth class of smoothness and such exactness of execution that the taper and ovalness of the part for the whole of its length are kept within limits of 0.01 mm. The cylinder shafts machined on this lathe are so smooth that they do not require honing (photo 6).

In the current year a new milling machine was installed; this machine was made to a special order by the Wagner firm (West Germany). On this milling machine will be possible to machine parts of the largest engines weighting up to 120 tons, and the length of the milling operation on this machine will amount to 13,000 mm.

An interesting process is the machining of the eccentrics; this takes place on a special Swiss combination milling machine-grinder of the HRF-500 type with a hydrauling attachment. This machine permits the operations of both milling and grinding of the eccentrics (Illustration 7).

The assembly department of the engine plant now has 104 work stands for assembling and testing. This makes possible the simultaneous assembling of five engines of the 6RD76 type, as well as the carrying out of tests on the 3D55 engine on the test stand of the Experimental Station of the Bureau for Construction of the engine plant. The assembly hall does not yet have all the accommodations for assembling large engines. Despite the lowering of the assembly stands 1.5 meters below the floor, the movements of the travelling cranes is still limited because of the low ceiling in the assembly hall (Illustration 8).

The testing equipment presently available permit the testing of the engines with heavy fuel of viscosity of up to 3500 sec. R (Redwood stickiness; outflow time of oil from a tube of 50 cm^3). All the processes of oiling, cooling and fueling etc, necessary to keep the engine in motion take place in a way analogical to those in a ship's engine room (photo 9).

A new assembly hall is now in the process of construction, which will have 10 work stands for assembly and testing.

It is impossible to discuss and illustrate all the equipment of the engine plant in one article, especially since the rebuilding of the plant is still going on; this rebuilding will keep pace with the development of production envisioned in the long range plan.

Review of Produced Engines

By the end of 1960 the factory had turned out nine engines -- eight of the 6RSAD76 type, each of 7800 h.p. at 119 rpm, and one engine of the 6RD76 type, also of 7800 h.p. at 119 rpm (this latter is a modernized version of the 6RSAD76 engine). Some of these engines have already been installed in 10,000-ton ships, such as "Jan Matejko" and "Hanoi" (Illustration 10). The remaining engines are in the last stages of being installed in ships of 10,000 displacement, namely "Phenian", "Dzakarta" and

in a ship of 19,000 displacement, "Prof M. Huber", built in the Gdansk and Szczecin shipyards.

Engines of the 6RSAD76 type are six-cylinder, two-stroke, transverse scavenged, single-acting, directly reversible engines designed for direct coupling to the propeller. The cylinder bore is 760 mm, piston stroke 1550 mm. Weight of the complete engine is 380 tons; length 11000 mm, height 9200 mm. These engines, as are all engines, are started with compressed air of 30 atmospheres maximum pressure. The cooling of the engine is by means of fresh water in closed circulation. The pistons are cooled with oil. Fuel consumption in these engines amounts to 156 g/h.p.h at full power, that is 7800 h.p. at 119 rpm (power of one cylinder is 1300 h.p.). These engines are designed for burning heavy fuel of viscosity of up to 3500 second R.

The 3D55 experimental 3-cylinder engine completed and tested for the first time in April 1958 has been working with some interruptions for close to three years on the experimental stand of the engine plant. The experiments are conducted by the Construction Bureau of the plant, which has the proper equipment and the most modern measuring and research tools (Illustration 11).

The research already conducted on the 3D55 engine permits the evaluation of the design and the selection of certain solutions and specifications for the 9D55. Observations of the work of the different research crews and an analysis of the results should form a basis for further improvements and changes for future engines of this type.

Review of Current Production

The first engine of the 6RD76 type, completed this year, began a new series of engines of the RD family, built on the basis of the patent of the Sulzer firm (Illustration 12). In the current year the H. Cegielski plants are completing nine six-cylinder engines of the 6RD76 type and one five-cylinder engine of the 5RD76 type. In these engines the value of the parts produced in the H. Cegielski plants comprise 98.3% of the value of all parts of the engine.

The engines of the RD76 type are new engines whose design is derived from the RSAD type. These are also two-stroke engines with transverse scavenging, single-acting, directly reversible with the fuel intake by means of a turbo-compressor. Cylinder bore is 760 mm, piston stroke, 1550 mm, full weight 370 ton, length 11,000 mm, height 9,200 mm. Fuel consumption in these engines amounts to about 152 g/h.p.h at full power, that is 1500 h.p. per cylinder at 119 rpm. (Full power of the 6RD76 engine -- 9000 h.p.) These engines are also adapted for burning heavy fuels.

The nominal power of the RD76 engines has been increased as compared with that of the RSAD76 engines. Average useful pressure in the RSAD76 engines, $p_e = 6.97$ kG/cm^2, in the RD76 engines -- $p_e = 8.06$ kG/cm^2. The increase in power required the introduction of water for cooling the pistons instead of oil, as was the case previously.

The most basic changes in the design of the RD76 engines as compared with the preceding RSAD76 type, are, apart from small details, the following:

--Changes in the design and location of the air cleaner;

--Change in the location of the intake valves,

--Change in the drive of the cams on the exhaust side,

--Change in design of the connecting rod system,

--Change in design of the maneuvering stand and steering system.

These basic changes have brought about that the RD76 engines have certain advantages as compared with the old RSAD76 engines.

1. The location of the air container on the exhaust side makes possible the shortest connection of the turboblowers with the exhaust fumes and the container. Beyond this there is a gain in the savings of materials and in reduction in the weight of the engine. There was also some space saved when the air cooler was built into the air container.

2. The transfer of the intake valves to a new location and the coupling of their drive by means of geared wheels posseses a whole number of advantages. Among these is the elimination of the independent drives of the cams which made it possible to shorten the valve as well as the valve housing.

3. The adaptation of a new drive for the cams on the exhaust side has, aside from the necessity of introducing a new arrangement for resteering the whole of the rods for "reverse" runs of the engine, considerably simplified the construction, giving savings in space and in weight; it also saved work in producing the engine. The steady revolving movement of the rods with the number of revolutions only half of those of the engine assures the bearings better lubrication and longer life.

4. There are great advantages in the new connecting rod system. The fact that the crosshead extends on both sides gives the whole system a greater assuredness of motion. The lack of tilts which exist in the old system of the RSAD, where the crosshead is only on one side, makes possible, with the symmetrical form of the connecting rods in the RD type, the motion of the engine at "reverse" with the same load as when at "forward". Such features are generally lacking in the engines with one-sided crossheads since in that case the pressure is greater on one side and thus produces a tilt. The construction of the connecting rod system in the RD makes possible a complete reversing of the engine without fear of damage. A great advantage of the new arrangement of the connecting rod system is that the head of the connecting rods are in one piece, instead of the bifurcation existing in practically all engines (with the exception of SD60 and SD72). The uniformity of the head of the connecting rod eliminates the possibility of deformation (Illustrations 13 and 14).

5. The introduced modification in the control stand for the RD engines is also to be regarded as advantageous, since it facilitates to a certain degree the control of the engine and its inspection. This concerns mainly the operations of the starting lever. Starting and control of the engine which in the old RSAD engines was a function of the positions of the throttle, the starting lever and, to a certain degree, also of the

engine room retelegraph, is transferred in the new arrangement of the RD to the crew of the retelegraph and of the throttle. The starting lever in this system is used only for starting the engine. It is necessary to state that to a certain degree the service of the lever stand is simplified at the moment when it requires the utmost attention from the engineer. After shifting the retelegraph in accordance with the signal from the bridge the engineer executes no actions which have a bearing on the directions of the revolutions of the engine. Since the setting of the retelegraph decides the direction of the engine starting, the possibility of errors by the engineer is eliminated.

The main advantages of the new technical solutions discussed above do not exhaust the issue of the superiority of the RD type over that of RSAD. For one of the greatest advantages of the RD engine is the easy access to all main elements of the engine, making possible a good inspection while the engine is running and making disassembling and changing of parts easy. The work of disassembling and assembling is furthermore facilitated by a number of simple tools. These features will be appreciated above all by ship's mechanics who are doing inspection and repair work in the narrow confines of the engine room.

In the current year will be completed the assembly and testing of the first prototype engine of Polish construction of the 9D55 type of 5000 h.p. at 150 rpm. (Illustration 15). This is a nine-cylinder, two-stroke, longitudinally scavenged (three exhaust bars), single-acting, connecting rod, directly reversible with fuel intake by means of a turbo-compressor. The cylinder bore is 550 mm; piston stroke, 1000 mm; width of the base, 2800 mm; length 10,900 mm, height 6450 mm.

Next will be assembled a second engine of this type the installation of which in a ship is foreseen by the end of 1961.

Both 9D55 engines were produced for the Szczecin shipyard and will be installed in small ships of 6000 ton displacement, of the B55 type, assigned to Polish Ocean Lines.

Production In Preparation

The Sulzer firm has built a number of engine types, of both high and low power, all based on the same design principles as the RD76 engine. These are the RD90, RD68, and RD56 engines. All these together form the RD family of engines. This engine family is the most modern expression in the field of high power, marine engine building. Data characterizing this family of engines are given in Table 1.

All the engines in Table 1 are in production program of the H. Cegielski plants.

At present the Design Bureau of the Engine Division of the H. Cegielski plants are already making preparations for the construction of the 6RD68 engines, of which the first should be completed in 1962. A prototype RD56 engine, which is to start the serial production of this engine, will be completed in 1963, and a prototype RD90 engine, which is to start the serial production of this engine, will be completed in 1965.

Because of the analogical construction of all these types the production of particular engines is made easier.

Table 1

Data for the Engines of the RD Family

Type of engine	Number of cylinders	Diameter of the cylinder in mm	Piston stroke in mm	Nominal power of one cylinder in h.p.	Revolution speed in rpm
RD56	5 and 12	560	1000	750	170
RD68	5 and 12	680	1250	1100	135
RD76	5 and 12	760	1550	1500	119
RD90	6 and 12	900	1550	2200	119

The similarity of technological processes and thus of tooling will shorten the production cycle and lessen production costs.

Also being prepared for future production (in the Gdansk shipyard) is the engine of the 562 VT2BF 140 type of 1090 h.p. per cylinder at 135 rpm; this engine is based on a patent of the Danish firm Burmeister & Wain. The first engine of this type will be completed by the H. Cegielski plants in 1963.

The engines of the 562 VT2BF 140 type are five-cylinder, two-stroke, longitudinally scavenged (one large exhuast bar in the head part), single-acting, directly reversible with fuel intake by means of a turbo-compressor. Cylinder bore is 620 mm, piston stroke 1400 mm (Illustration 16).

Future production plans envision the further production of the D55 engine with the required number of cylinders. At present these engines are planned to have six cylinders.

Illustration Captions

Illustration 1. First 6RSAD76 engine on the test stand in the H. Cegielski plants in Poznan.
Illustration 2. Part of the base of the 6RD76 engine during welding.
Illustration 3. Milling of the posts of the 6RD76 engine on a combination planer-milling machine.
Illustration 4. Machining of the seats of the main bearings.
Illustration 5. Turning the surface of the cylinder shafts on a TRB160 lathe.
Illustration 6. Machining the inner side of the cylinder on the BZS300 vertical lathe (or boring mill).
Illustration 7. Inspecting of an eccentric; to the right is seen an HRF500 combination milling machine-grinder.
Illustration 8. Assembly hall with the engines 6RSAD76, 6RD76, 9D55 and 3D55.
Illustration 9. Cooling tower for cooling the water for the external cooling of the engine (instead of sea water).
Illustration 10. Ten-thousand-ton ship "Hanoi" equipped with the 6RSAD76 engine.
Illustration 11. Measuring of oil pressure in the connecting rod bearings of the 3D55 engine while it is in motion.
Illustration 12. 6RD76 engine on the test stand.
Illustration 13. Examining possible deformations in the connecting rod of the 9D55 engine.
Illustration 14. Connecting rods of the 6RD76 engine.
Illustration 15. Assembly of the prototype 9D55 engine.
Illustration 16. Cross section of the 562 VT2BF 140 engine.

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